



National Aeronautics and Space Administration

NRT Airborne Science

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27 September 2016



Airborne Science Elements of Excellence

- **Airborne Science Infrastructure**
 - Next generation airborne sensor network
 - Integrated infrastructure for disaster response
- **Airborne Science Manned Aircraft**
 - B200
 - King Air
 - C130
 - ER-2
 - DC-8
 - P-3
- **Airborne Science Unmanned Aircraft**
 - Dragon Eye and Raven
 - Ikhana (Predator-B)
 - Global Hawk
- **Advanced Visualization Tools**
 - MTS - Mission Tools Suite and beyond



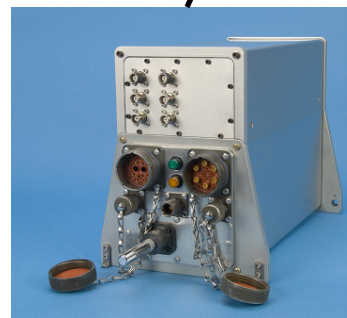
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Next generation onboard data networks and payload interfaces

Global Hawk Payload Data System



NASDAT Network
Server



Experiment
Interface Panels



Telemetry and
Payload
Computer



Master Payload Control System



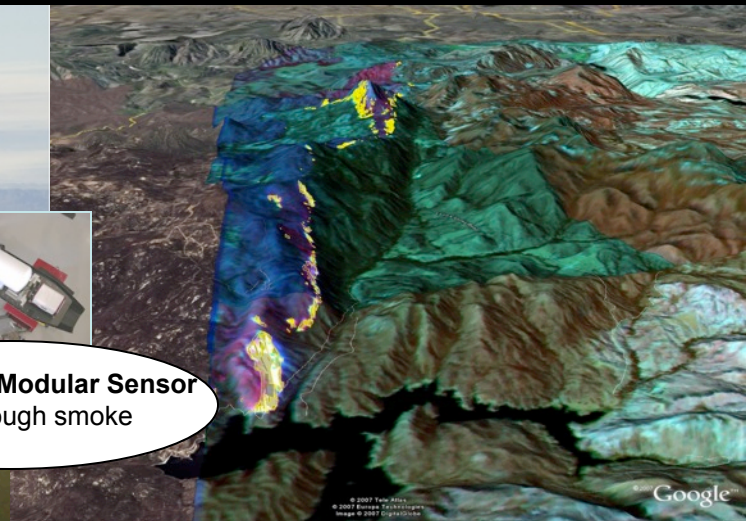
Natural Hazard Response



NASA Ikhana



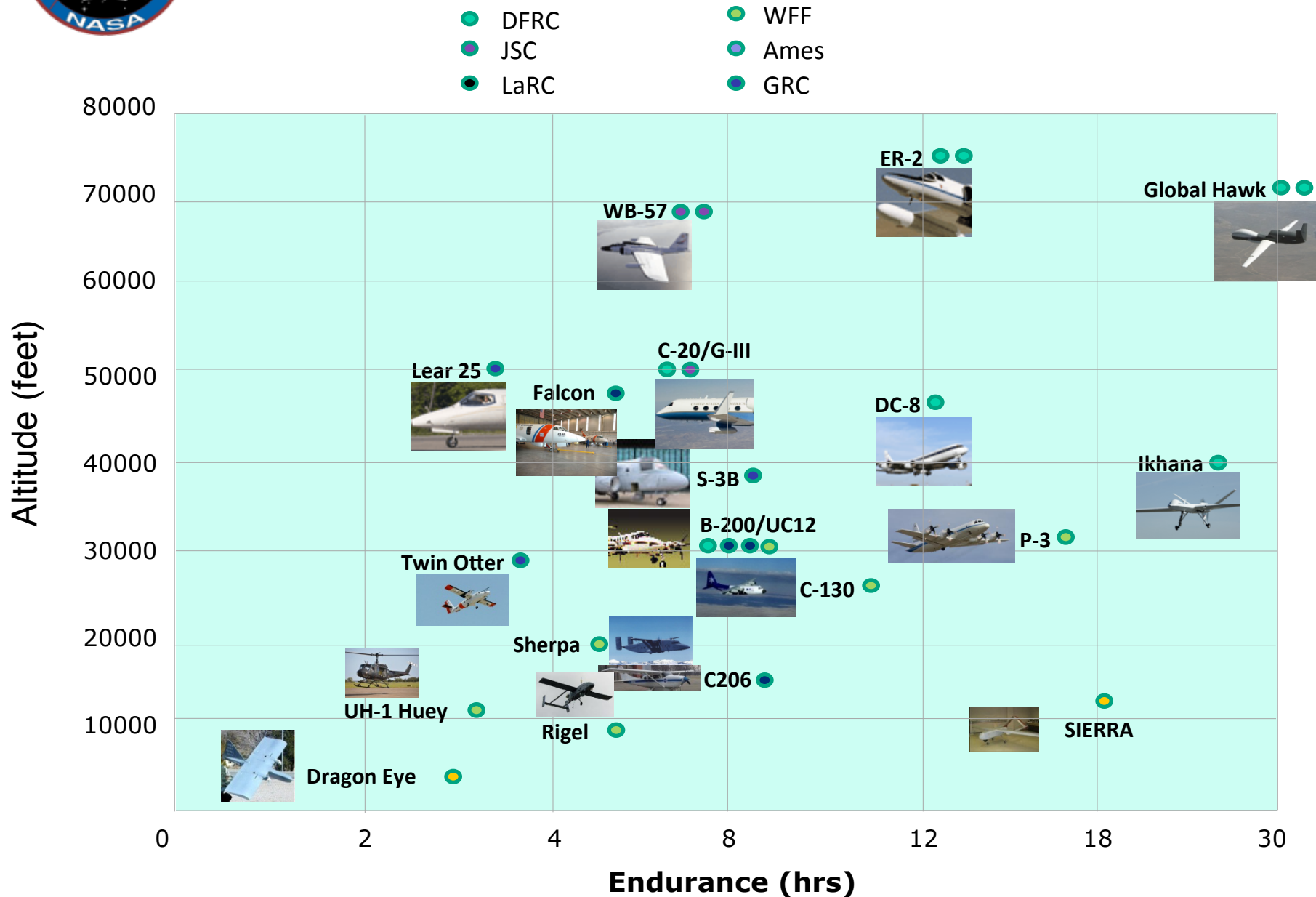
Autonomous Modular Sensor
Sees through smoke



Collaborative Decision Environment
Real time Information Direct to
First Responders



NASA Earth Science Research Capable Aircraft





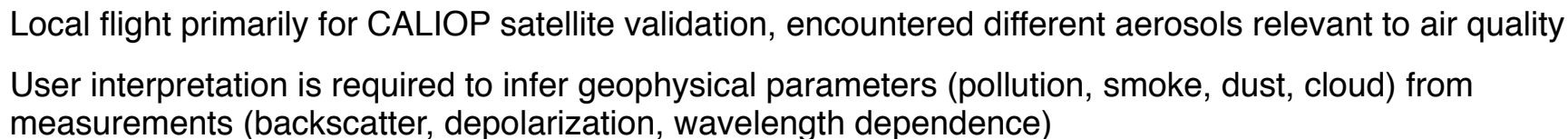
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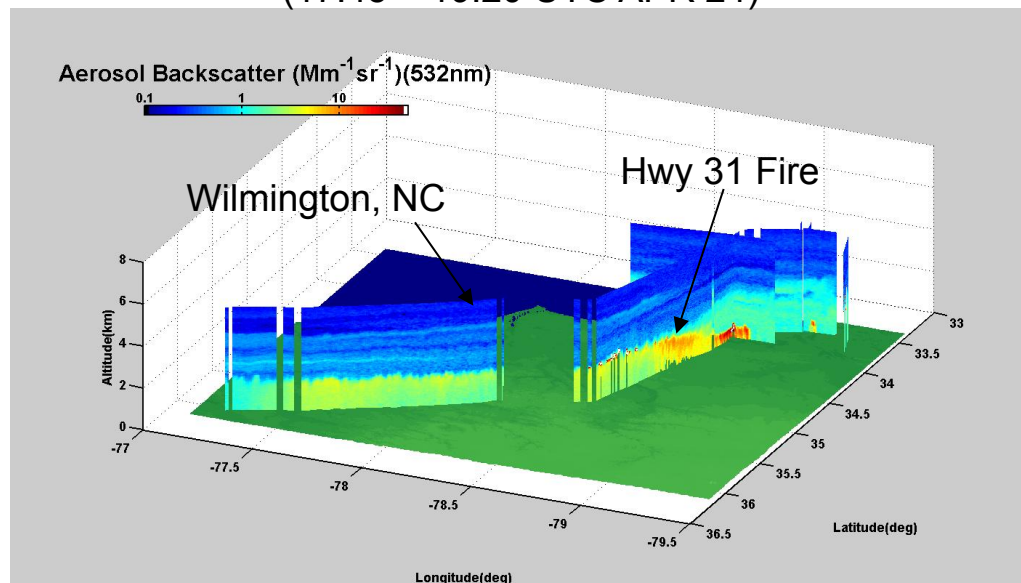
NASA B200 and High Spectral Resolution Lidar (HSRL) Deployment in Support of US EPA



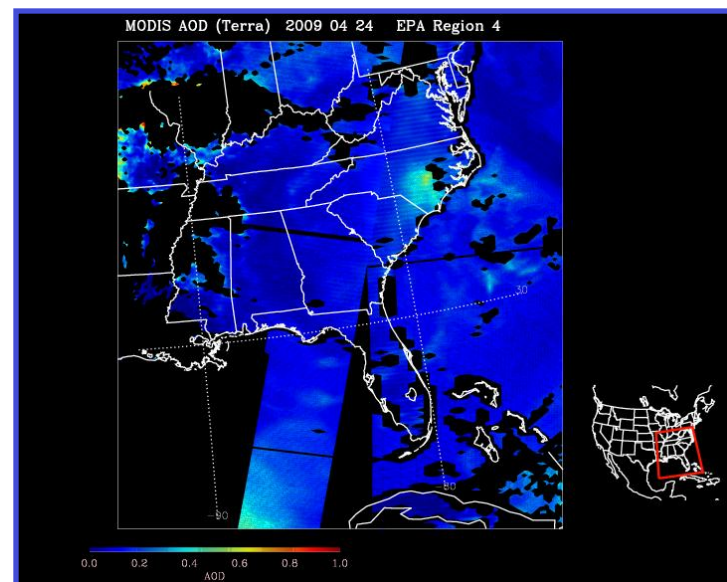
Measurements of Myrtle Beach Fires on April 24:

- April 23 US EPA requests HSRL overflights of SC fires using NASA B200 King Air
- Existing HSRL configuration allowed for rapid deployment from NASA LaRC on April 24
- Satisfied US EPA science requirements to measure aerosol distribution related to fire plume rise and aerosol extinction for biomass emission estimates

B-200-HSRL Overflights of SC Highway 31 Fire
(17:45 – 19:20 UTC APR 24)



MODIS-TERRA AOD captures aerosols
from SC fires - 15:30 UTC APR 24



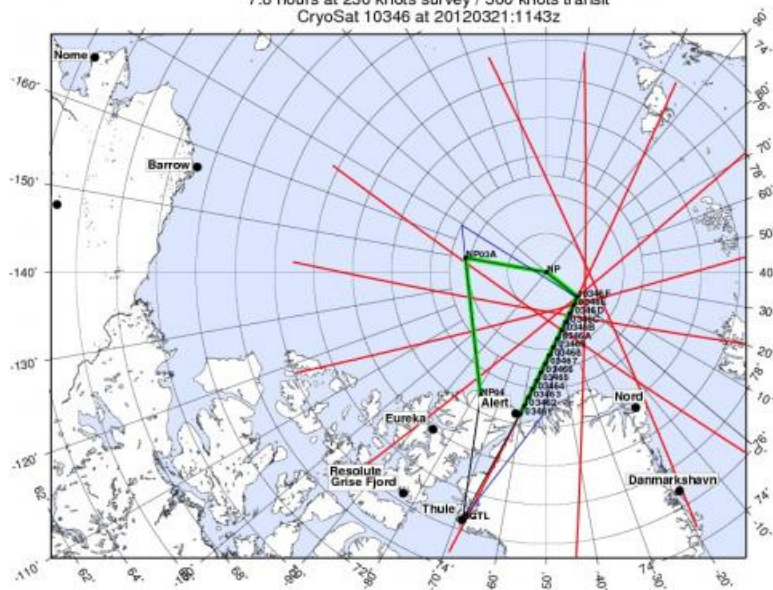


P-3 and DC-8 – Operation IceBridge

- **Operation IceBridge**
 - IceBridge, a six-year NASA mission, is the largest airborne survey of Earth's polar ice ever flown. It will yield an unprecedented three-dimensional view of Arctic and Antarctic ice sheets, ice shelves and sea ice. These flights will provide a yearly, multi-instrument look at the behavior of the rapidly changing features of the Greenland and Antarctic ice.

Sea Ice - North Pole Transect

7.8 hours at 230 knots survey / 300 knots transit
CryoSat 10346 at 20120321:1143z





ER-2 and P-3 - Oracles

■ ORACLES

- Southern Africa produces almost a third of the Earth's biomass burning (BB) aerosol particles, yet the fate of these particles and their influence on regional and global climate is poorly understood. **ORACLES (ObseRVations of Aerosols above CLouds and their intEractionS)** is a five year investigation with three Intensive Observation Periods (IOP) designed to study key processes that determine the climate impacts of African BB aerosols.



Instruments on ER-2

Enhanced MODIS Airborne Simulator (eMAS)	Platnick/Myers (NASA GSFC/ARC)
Solar Spectral Flux Radiometer (SSFR)	Schmidt/Pilewskie/Gore (CU/ ARC)
High Spectral Resolution Lidar (HSRL-2)	Hostetler/Ferrare (NASA LaRC)
Research Scanning Polarimeter (RSP)	Cairns (NASA GISS)
Airborne Multiangle SpectroPolarimetric Imager (AirMSPI)	Diner (JPL)

Instruments on P-3

Spectrometer for Sky-Scanning, Sun-Tracking Atmospheric Research (4STAR)	Russell (NASA ARC)
Cloud in situ	McFarquhar/Poellot (UI/UND)
Solar Spectral Flux Radiometer (SSFR)	Schmidt/Pilewskie (CU)
CO Measurement Activity (COMA)	Podolske (NASA ARC)
Aerosol & cloud in situ - Hawaii Group for Environmental Aerosol Research (HiGEAR)	Howell/Clarke/Small (UH)
Airborne Cloud/Precipitation Radar (ACR/APR-2)	Tanelli (JPL)
High Spectral Resolution Lidar (HSRL-2)	Hostetler/Ferrare (NASA LaRC)
Research Scanning Polarimeter (RSP)	Cairns (NASA GISS)



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Small UAS Development





Dragon Eye Deployment to Turrialba Volcano in Costa Rica in Support of ASTER SO₂ Data Product Validation

The RQ-14 Dragon Eye sUAVs were recently acquired by NASA from the U.S. Marine Corps via GSA to support this mission—good example of civilian repurposing of military hardware

Flights occurred from March 10-13, 2013

5 science flights with SO₂ sensor and 1 science flight with thermal camera (7-12 μ m band)

SO₂ concentrations of ~6-20 ppm were detected throughout the day

Collected measurements in the volcano plume coincident with an ASTER overpass

Expanded flight envelope up to 12,500 ft ASL from 8,000 ft ASL published operational ceiling

Next deployment in 2015 will include the SIERRA UAV carrying a mass spectrometer and other instruments + Dragon Eye

Funded by NASA Earth Surface & Interior Focus Area (John Labrecque) and the University of Costa Rica (Prof. Jorge Andres Diaz, Co-I)

US Team from NASA JPL, ARC, WFF

Other participants/advisors

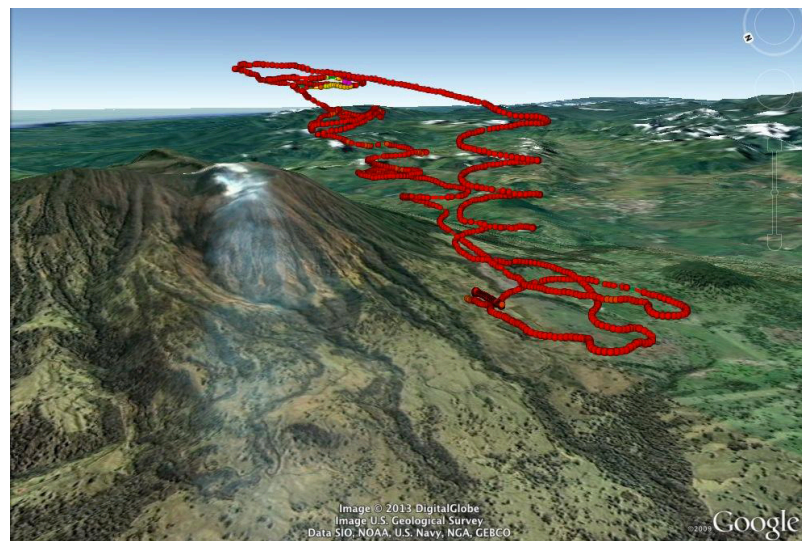
Applied Sciences University Düsseldorf (Germany)

RadMet LLC (Redwood City, CA)

Teledaq LLC (Santa Clarita, CA)

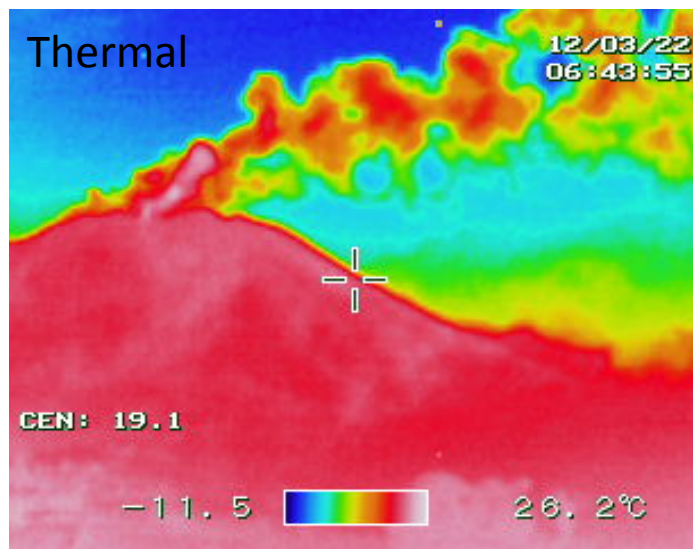
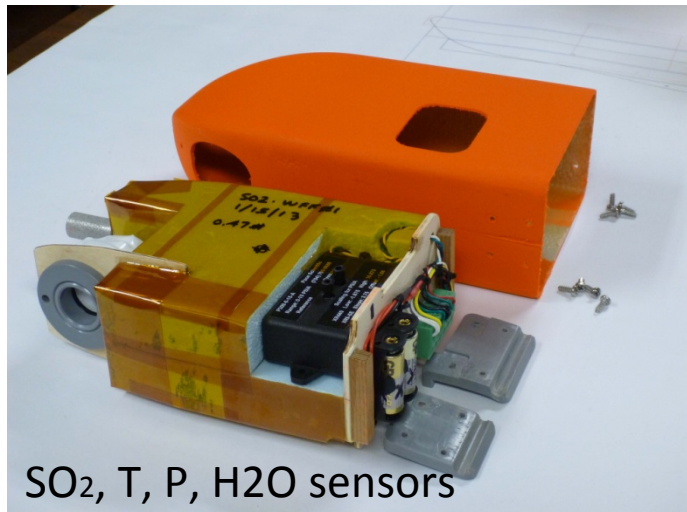
Aerovironment, Inc. (Monrovia, CA)

Principal Investigator: David C. Pieri (JPL)





Compact Sulfur Dioxide sensor package for Dragon Eye UAS: *"In situ validation and calibration of remotely sensed volcanic emission data and models"* (Pieri, et al)





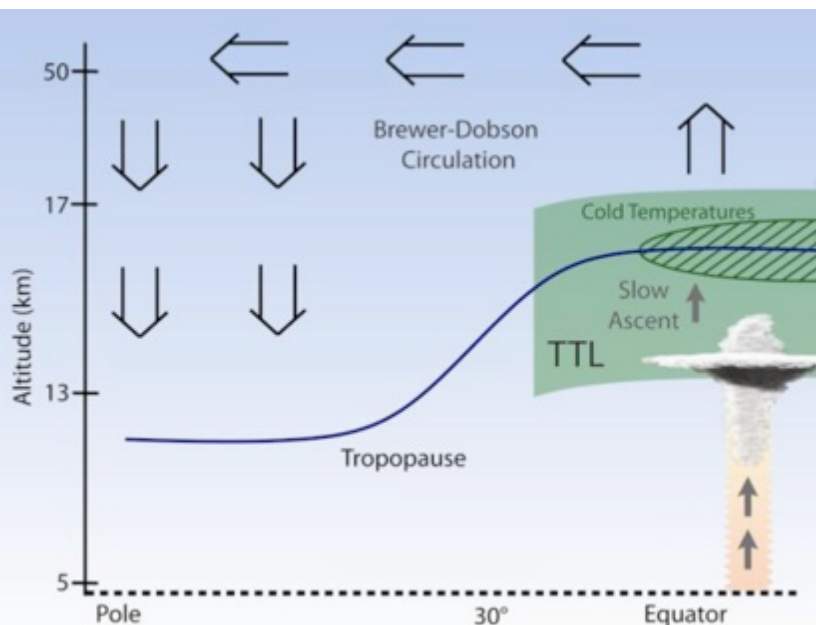
ATTREX

Airborne Tropical Tropopause Experiment

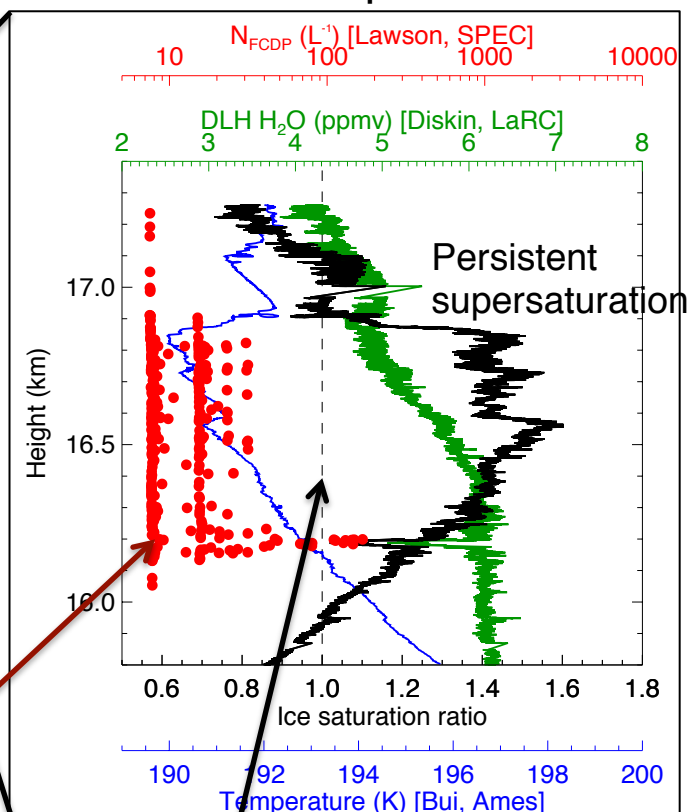
PI: Dr. Eric Jensen, NASA Ames

“Leaky Tropopause”

Vertical profile



Too few ice crystals to effectively
deplete excess H₂O vapor



Global models assume no supersaturation ($S_{ice} \leq 1$)

*Jensen et al., PNAS
(2013) 110, 2041.*



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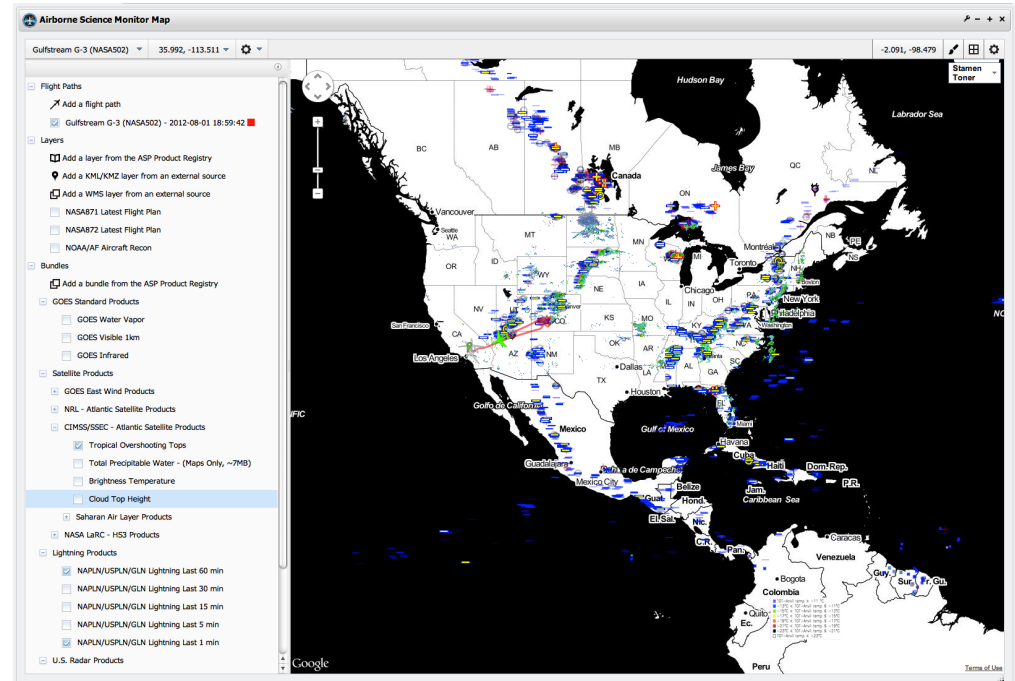
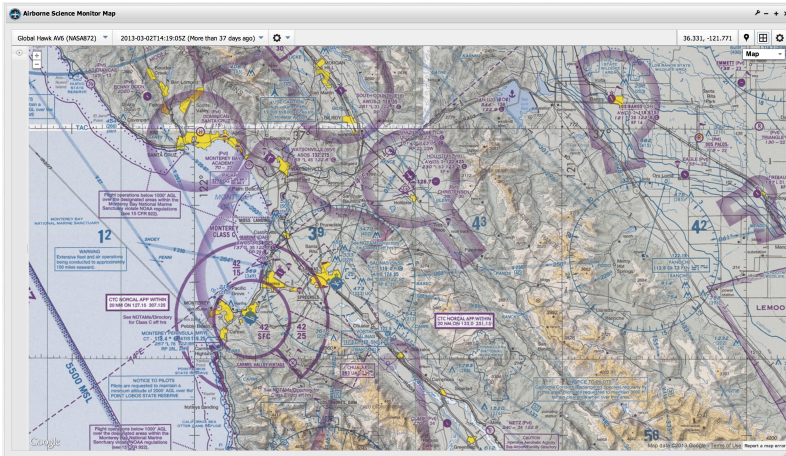
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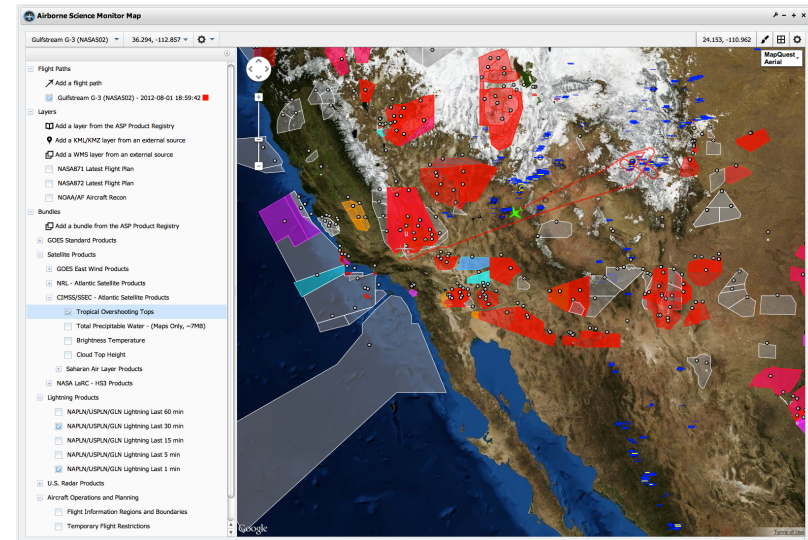
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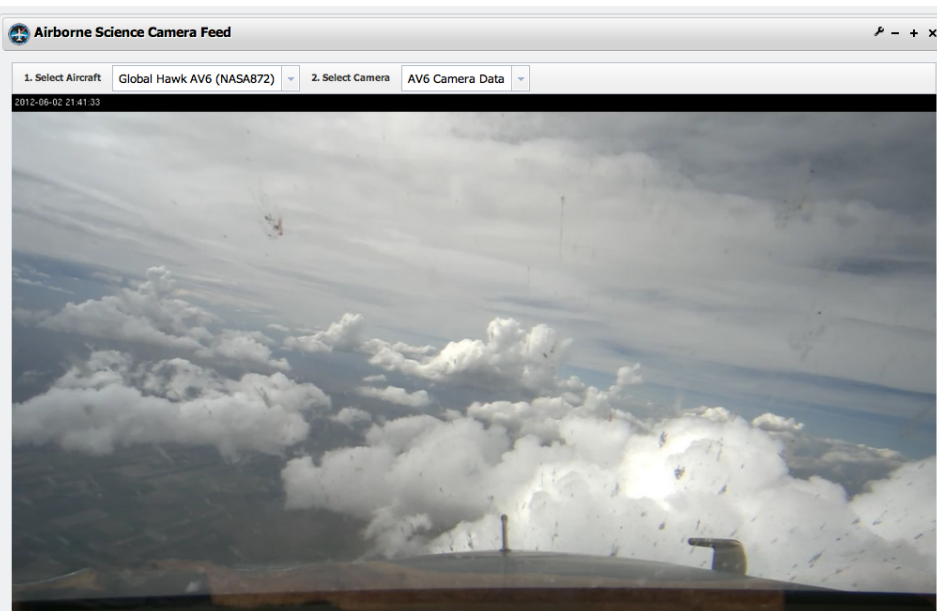
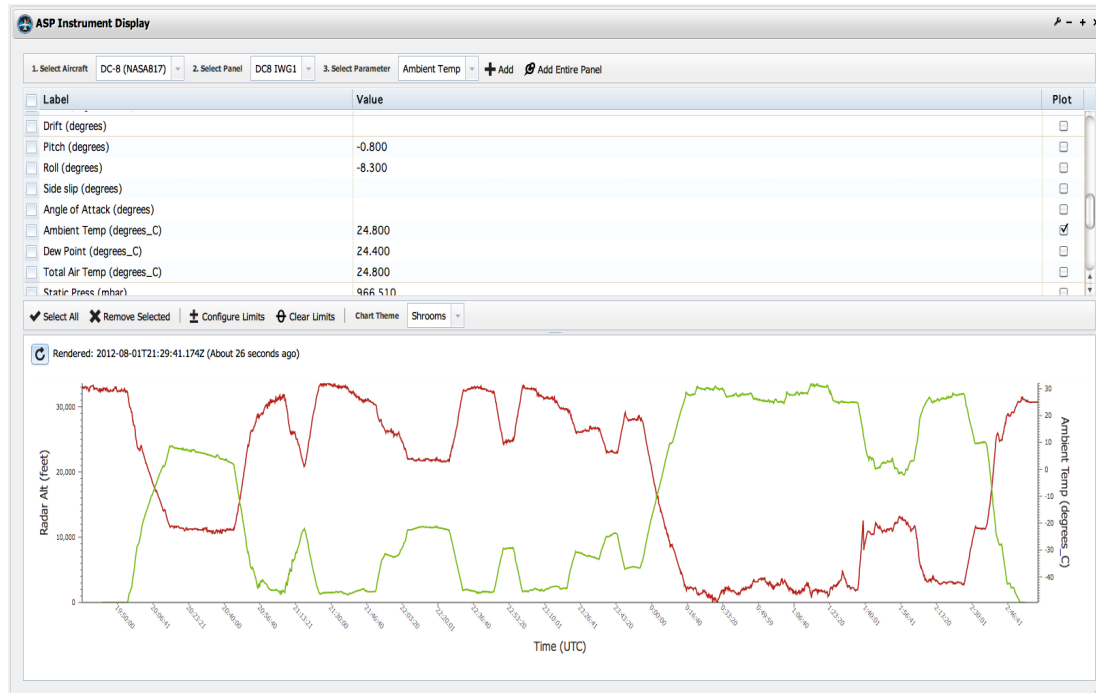
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MTS – a suite of web based software tools to increase the efficiency and effectiveness Earth Science Airborne Campaigns

- Real time aircraft tracking and instrument telemetry
- Customized user and project workspaces
- Team communication and collaboration tools for shared situational awareness
- Integrated single and multi-user chat client
- Comprehensive ingest and streamlined display for KML, WMS, TMS data products
- Plotting and graphing
- Complementary tools for education
- Mobile tracking





Airborne Science Chat Client

Connections

- rdcc.guest.ucar.edu:6668
 - #airbornescience
 - #WB57
 - #AERO
 - #AO2MED
 - #help
 - #IFEX
 - #GRIP
 - #RADR
 - #aamps
 - #MESO
 - #HSRL**

rdcc.guest.ucar.edu:6668 (62 Rooms)

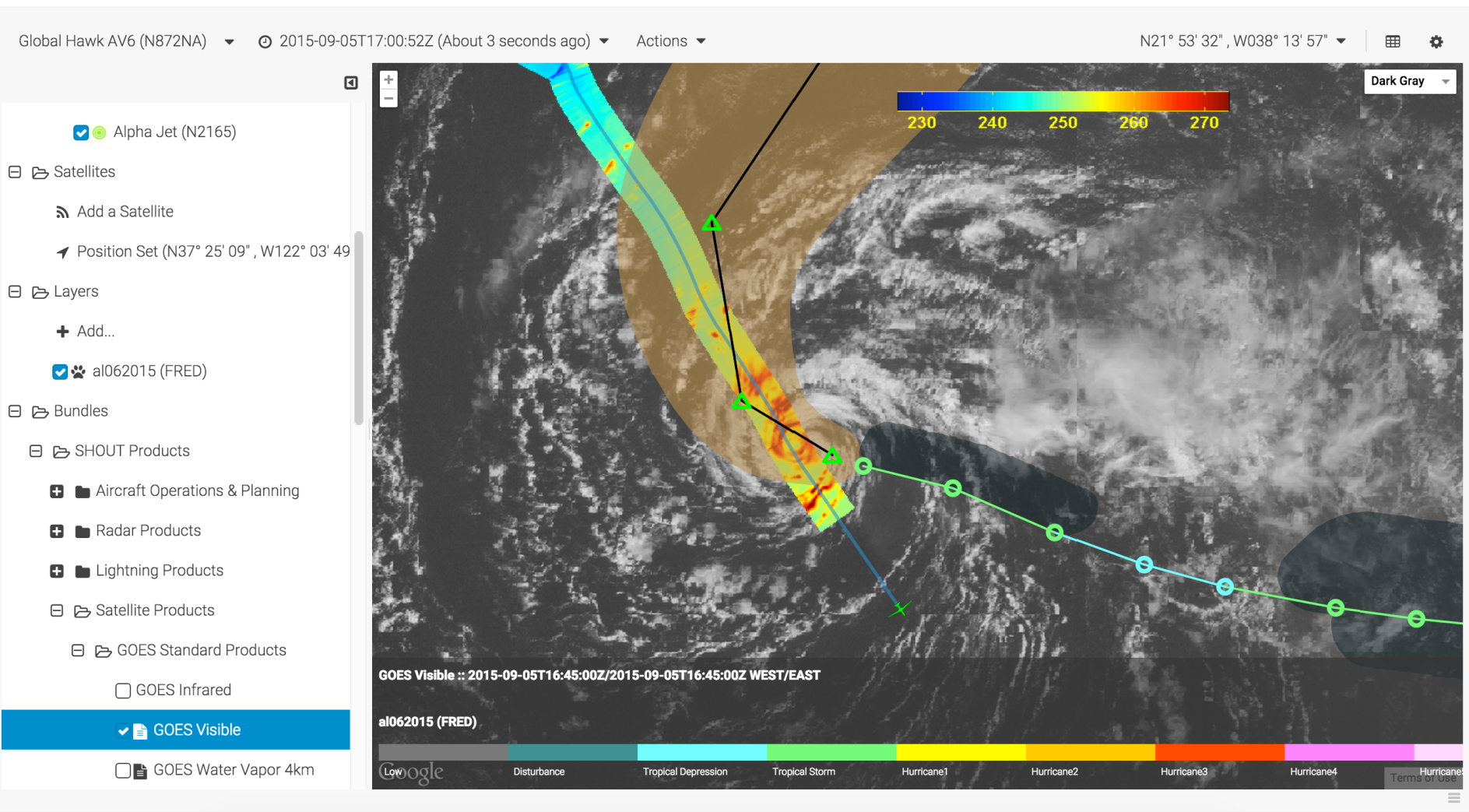
Name	Users
#Driftsonde	1
#WB57	1
#AERO	1
#AO2MED	1
#help	1
#IFEX	1
#GRIP	1
#RADR	1
#aamps	3
#MESO	1
#HSRL	1
#bot	1
#FEEDS	2

Join Selected Channels or Input Channel Name

Change Layout

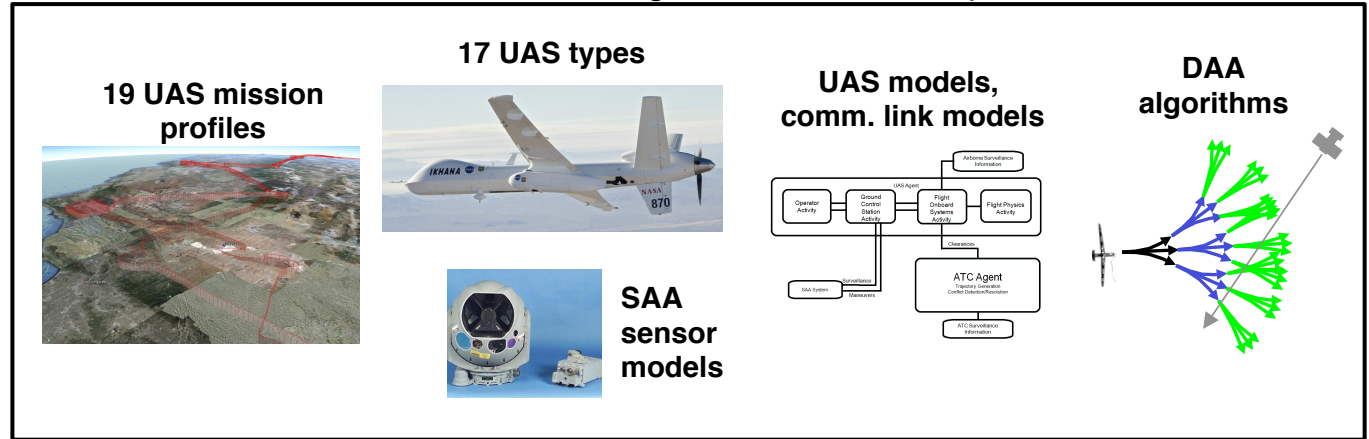
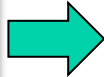
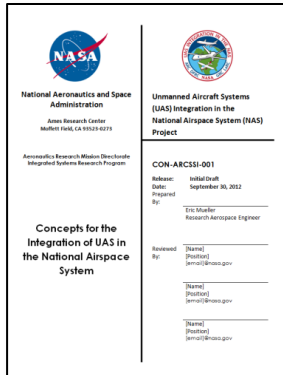


Sensing Hazards with Operational Unmanned Technology





New UAS-related modeling and simulation capabilities

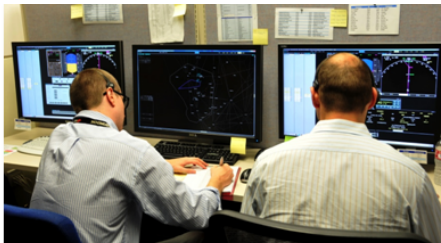


UAS-NAS
integration concepts



Human-in-the-Loop Evaluation

Pseudo-
pilot
stations



Air Traffic Control Stations

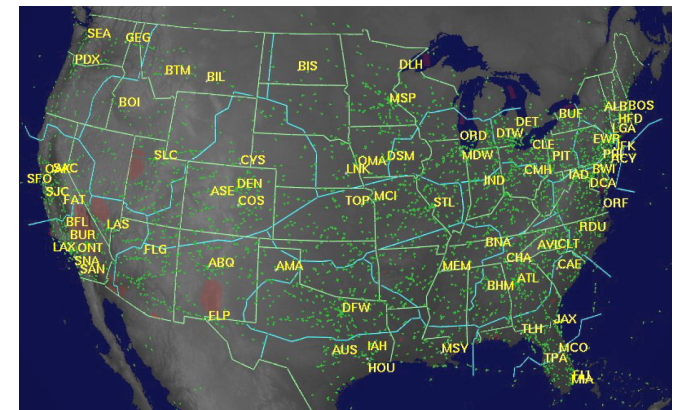


Vigilant Spirit Control Station

Traffic displays, DAA algorithms, ATC, Ground Control Station



NAS-wide Simulation



ACES: Flight plan and NAS-agent
modeling system



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***Thank You !
Don Sullivan***

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